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(54) Magnetic head carriage for hard disc drive

(57) A carriage for a hard disc drive polished as final finish has high surface precision of micron order. The finish surface is smooth, a cutting trace does not exist, and the surface layer is hardened uniformly by a magnetic material being hit by magnetic power. A cutting bur the edge of which is very tiny does not fall after installing the hard disc drive. The carriage for the magnetic head of the hard disc is not influenced by a temperature change and a seasonal change. The present application discloses a magnetic polishing brush keeping magnetic abrasive material between magnetic poles (16,17) to polish the carriage such as a head arm member (1) formed by extrusion molding or drawing for the magnetic head of the hard disc drive. The carriage of non-magnetic material such as an aluminum part of HDD inserted in the above described magnetic polishing brush, is given reciprocation motion and vibration, thus the surface of the above described part is polished. The final finish is made by magnetic beam processing to polish or remove burs. Further, surface polish as final finish of the carriage is made by the above described magnetic beam processing using feeble magnetism, the relative magnetic permeability of which is 1.5 to 200, as the above described abrasive material. Further, stainless steel, nickel alloy or iron alloy having the same hardness as said stainless steel are used as the above described polish material.

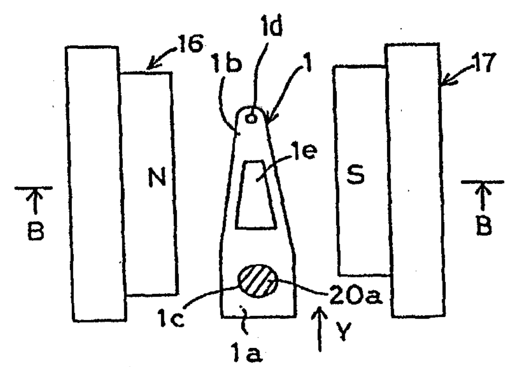

FIG. 10A

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processing or surface treatment for precision parts having the hole or the opening inside and the narrow wide slit outside, thus there is another problem in which the capability of producing a variety of products is disturbed.

[0008] Further, there are electrolytic polishing, a shot method, or an ultrasonic method as a polishing method for those portions. There are defective points in which dimensional tolerance of each plate member is not capable of being solved if the bur is removed enough by electrolytic polishing and inside processing is impossible although outside surface processing is possible by the shot method. Further, the ultrasonic method does not have enough power to remove the bur, thus processing becomes uneven. Thus, those processing methods are not capable of being used because the surface shape inside the comb teeth made with a micron accuracy is destroyed. Unavoidably, those portions are processed by a brush by the human being's hand using abrasive material. Thus, there have been defective points in which polish efficiency has been very bad and the cost would be high because one hundred percent test has been required since the polish processing has been made by the human being's hand. Further, the bad quality rate based on processing has been high.

[0009] The applicant discloses a method and an apparatus in which the bur of the surface beyond one's reach or inside nonmagnetic parts is removed using a machine using magnetic beam processing additionally, so called magnetic polishing.

[0010] Here, surface finishing polish for the above described carriage based on the conventional manual processing is explained in detail. Conventionally, firstly, the big bur which can be seen by one's eye is removed roughly by rotating a metal brush as shown in Figs. 4A, 4B, and 4C. The above described metal brush has the structure in which a number of wire brushes grow densely in a prop 14 in the same circle direction as shown in Figs. 4A, 4B, and 4C, and, as shown in Fig. 4A, polish processing is made in such a way that the prop is rotated in the arrow direction and then the above described carriage is pressed by one's hand from one side. After the above described rough polish processing is finished, then small burs are removed by cutting with a knife using a microscope. In Figs. 5 and 6, the picture of the carriage surface finished by the manual processing is shown. Here, Fig. 5 is a magnified picture of the portion of "A" of Fig. 7, and the magnification rate becomes bigger from the top to the bottom. Further, Fig. 16 is a magnified picture of the portion of "B" of Fig. 7, and the magnification rate becomes bigger from the top to the bottom.

[0011] As identified by the pictures clearly, one direction traces are kept in the carriage surface finished by manual processing. This phenomenon, as shown in Figs. 4A, 4B, and 4C, is based on processing in which the only conspicuous bur is cut with the knife using the microscope by one's hand after rough removal is made by the metal brush with manual processing. Accordingly, the most part of the surface is kept with the rough removal condition, namely final polish condition in which polish processing was made by the metal brush.

[0012] Accordingly, as shown in the pictures of Figs. 5 and 6, there are cutting stripe traces made mostly by the first rotating brush and kept on the finish surface. Further, face precision at least in the cutting portion would be dynamically beyond the range of a standard, 20 μm comb thickness, because cutting volume depends on one's pressure since small burs are cut by one's hand with the knife. Further, manual processing requires skill, does not keep uniform processing, and increases costs because processing efficiency goes down if excellent finish is required. Recently, as the production method for the magnetic head carriage of the above described HDD, there is a tendency in which the carriage is assembled using each plate produced by a press working. This based on the bur problem found in integral production. HDD rotates at high speed, the magnetic head employs a surface method, and a space between the head and the disc is 0.05 to 0.10 μm during disc's rotating, thus the head is so delicate as for surface stability to become unstable even if dust in the air enters in the space. Further, after the head collides the disc once, the situation caused by dust and a broken piece produced by collision between both of them becomes suddenly bad. As a result, crush occurs. Thus, metal chip should not exist there.

[0013] There is a risk, in which a small metal chip drops inside HDD by HDD vibration, for surface finish by manual processing. For one thing, although a tiny bur can be removed by the knife as explained before, scratch stripe traces by the metal brush are kept on most of surfaces and the small burs exist on the edge of the scratch stripe traces. Secondly, the tiny burs are removed by cutting work with the knife, so there exist still more tiny burs on the edge in which the burs are removed by the knife. Still, an oversight occurs since visual observation is applied. Final finish by manual processing not only increases costs since manual processing is a time consuming job, but also occurs the above described defect points on the finish surface.

[0014] Figs. 8 and 9 are pictures showing surface conditions by electrolytic polishing for reference. Figs. 8 and 9 are magnified pictures of "A" and "B" of Fig. 7 in the same way as Figs. 5 and 6. Here, referring to electrolytic polishing, the surface is smooth like a mirror according to electrolytic polishing, so the tiny bur exists little on the surface since electrolytic polishing is capable of polishing powerfully than magnetic polishing of the present invention or the conventional manual processing. The biggest defect point of electrolytic polishing, however, is the impossibility for the polish extent not to be capable of being controlled. Generally speaking, the burs do not exist in the same way, but the size of the burs differ in the various way. The surface precision deteriorates since the tiny burs are removed excessively if electro-

magnetic beam processing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The above object and features of the present invention will be more apparent from the following description of the preferred embodiments with reference to the accompanying drawings wherein:

Fig. 1 is the general view of a carriage as a head arm member of a hard disk drive (HDD) of a computer for the magnetic beam processing polish of the present invention;
Fig. 2A illustrates a general view for explaining a general composition for a head arm portion of a magnetic disc assembly;
Fig. 2B illustrates the general view for explaining the general composition for the head arm portion of the magnetic disc assembly;
Fig. 3 illustrates the general view for the general composition for the head arm portion of the magnetic disc assembly;
Fig. 4A is a magnetic brush for removing rough burs as final polish stage of the carriage;
Fig. 4B is the magnetic brush for removing rough burs as final polish stage of the carriage;
Fig. 4C is the magnetic brush for removing rough burs as final polish stage of the carriage;
Fig. 5 is the picture of a surface of the carriage after burs removal finish is made by conventional manual polishing;
Fig. 6 is the other picture of a surface of the carriage after burs removal finish is made by conventional manual polishing;
Fig. 7 illustrates a spot pictured in Figs. 5, 8, 9, 6, 14, and 15;
Fig. 8 is the picture of the surface of the carriage after burs removal finish is made by electrolytic polishing;
Fig. 9 is the other picture of the surface of the carriage after burs removal finish is made by electrolytic polishing;
Fig. 10A illustrates a processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 10B illustrates the processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 11A is the explanatory view to explain another motion of the processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 11B is the explanatory view to explain another motion of the processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 11C is the explanatory view to explain another motion of the processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 11D is the explanatory view to explain another motion of the processing method using magnetic beam processing as magnetic polishing in order to form the carriage of the present invention;
Fig. 12 is the general view of magnetic beam processing as magnetic polishing applied in the present invention;
Fig. 13 illustrates the head arm member of the hard disc drive (HDD) as one research example of the present invention;
Fig. 14 is the picture of the surface of the carriage after burs removal finish is made by magnetic beam processing as magnetic polishing of the present invention;
Fig. 15 is the other picture of the surface of the carriage after burs removal finish is made by magnetic beam processing as magnetic polishing of the present invention;
Fig. 16 illustrates the motion of a metal brush used for rough bur removal;
Fig. 17A illustrates the example of polish by a magnetic polishing pin as magnetic abrasive material of the present invention;
Fig. 17B illustrates the example of polish by the magnetic polishing pin as magnetic abrasive material of the present invention;
Fig. 17C illustrates the example of polish by the magnetic polishing pin as magnetic abrasive material of the present invention;
Fig. 18A illustrates the polish process of magnetic beam processing as magnetic polishing of the present invention;
Fig. 18B illustrates the polish process of magnetic beam processing as magnetic polishing of the present invention;
Fig. 18c illustrates the polish process of magnetic beam processing as magnetic polishing of the present invention;
Fig. 18D illustrates the polish process of magnetic beam processing as magnetic polishing of the present invention;
Fig. 19A is the measurement result of the size of traces of a carriage surface measured by a surface roughness meter after burs removal finish is made by electrolytic polishing;
Fig. 19B is the measurement result of the size of traces of the carriage surface measured by the surface roughness meter after burs removal finish is made by electrolytic polishing;
Fig. 20A is the measurement result of the size of traces of a carriage surface measured by a surface roughness meter after burs removal finish is made by conventional manual polishing;
Fig. 20B is the measurement result of the size of

present invention. The magnetic pin does not contain remaining particles, still a fragment of the cutting edge of the pin turns to one direction at all times, processes, and works. Stainless steel is chosen as the magnetic pin in order for the construction to maintain the rustproof condition. The length and the value of the magnetic stainless steel are extremely important because they relate to the magnetic power based on unequal magnetic field. The edge, which is sharp and does not drop even if the processing pressure is given, is selected as the edge of the pin, and a cut-wire is enough used as the pin edge.

[0032] Further, for removing big burs by the edge fragment formed in the magnetic pin, it is required that the sharpness of the pin edge fragment be improved. Adding high frequency vibration harmoniously is desirable in order to improve the sharpness. Namely, it is highly recommended that big mutual frequency vibration and minute high frequency vibration are added effectively between the construction and the magnets and thus frequency adding effect is utilized. Further, it is expected that the mutual vibration movement between the above described construction and the magnets should be not one direction and one dimensional but ellipse causing cross effect of processing traces. Because, the above described cross effect improves bur removal efficiency and smoothes a surface rapidly.

[0033] When nonmagnetic material is discussed for processing, lines of magnetic force permeate the construction freely and cause the magnetic force as processing force to the above described magnetic abrasive material. The phenomenon that the lines of magnetic force permeate the material has the same meaning as the phenomenon that X-rays permeate the material, namely, that places beyond one's reach or sight can be processed effectively. Therefore, the above described magnetic processing enables the surface finish and the bur removal of the edge by applying processing power of the above described magnetic abrasive material to a spot beyond one's reach or sight.

[0034] Fig. 12 illustrates magnetic beam processing view for magnetic polishing of the present invention. The work 1 as the hard disc carriage is polished by a group of nylon brushes 24 containing rough polish grind particles or metal brushes of Figs. 4A, 4B, and 4C at first. Here, for the carriage, right and left sides of each plate member 1b are polished. Next, in the work 1, a support arm 20a of a robot is inserted in the support shaft hole 1c shown in Figs. 10A and 10B, a pointed end of the plate member 1b of the work 1 is inserted horizontally from Y direction between the magnetic pole (N) 16 and magnetic pole (S) 17 by the robot firmly supporting it, and the work 1 is inserted in the magnetic brush 18 and kept vertically in the middle position between magnetic pole (N) 16 and magnetic pole (S) 17. The reason why the pointed end of the plate member 1b of the work 1 is inserted from Y direction between the magnetic pole (N) 16 and the magnetic pole (S) 17 is because the width between magnetic pole (N) 16 and the magnetic pole (S) 17 should be wide and therefore the magnetic fields between the magnetic pole (N) 16 and the magnetic pole (S) 17 are not utilized effectively, if the side wall of the plate member 1b is inserted.

[0035] The work 1 is inserted in such a way that the magnetic abrasive materials are jostled through the way. The magnetic abrasive materials are magnetized and kept along with the magnetic beams between the N pole and the S pole, so they are rearranged along with the magnetic beams through which the above described magnetic abrasive materials pass after the work 1 has been inserted. Therefore, they are kept between the magnetic poles in such a way that they are inserted between the gaps 4 of the work 1 as shown in Fig. 13. Here, Fig. 13 is an explanatory view for easily showing the state of the magnetic abrasive material. In the actual application, the insertion way shown in Fig. 13 is not used because the precision, 20 μm as the width between the teeth of the comb, is destroyed by the deflection by processing if the teeth of the comb are made a right angle with the lines of the magnetic force. Accordingly, the insertion way, in which the teeth of the comb are made parallel with the lines of the magnetic force, of Figs. 10A, 10B, and 11A is used.

[0036] Thus, "the magnetic abrasive brush floated in the space" is formed in the teeth of the comb of the work 1 by the beams by the lines of the magnetic force. Then, vibration, X direction stroke of which is 7 mm, Y direction stroke of which is 1 mm, Z direction stroke of which is 1 mm, and frequency of which is 40 Hz, is added between the magnet poles 16 and 17. The above described vibration is yielded by non-circle crank, so vibration elements are yielded in the vertical direction of Figs. 10A and 10B and then elliptic movement is yielded. Vibration is yielded by not only mechanical generation means using the non-circle crank, but also electrical means. For polish as explained in the later part of the specification, however, it is much more effective for polish efficiency and smoothing processing that polish is made in the vertical direction of Figs. 10A and 10B as well since magnetic abrasive brushes are made in all the directions.

[0037] If the vibration is added to the magnetic poles 16 and 17 in X, Y, and Z directions with the position of Fig. 10B, the magnetic brush 18 vibrates as well in X, Y, and Z directions, the magnetic abrasive materials contact and vibrate for the work 1, and then polish is made in an angle area formed in an outer edge of the plate member 1b and the surfaces of right and back sides of the plate member 1b mainly. Although this way is capable of being applied to polish the surfaces of a plurality of plate members 1b of the work 1 mainly, the following way is made for polish when the burs in angle areas of deep positions inside the plate members 1b of the work 1 especially are removed with a high precision.

[0038] First, the magnetic poles 16 and 17 are vibrated in the horizontal and vertical directions in Fig.

tion power applied to the magnetic material in the x direction is in proportion to the particle diameter cubed, the magnetization rate of the magnetic material, magnetic field strength, and the changing rate of the magnetic field strength in the x direction.

[0044] Again, we go back to Fig. 12 of the whole schematic view showing the preferred embodiment of the magnetic beam processing apparatus employed by the present invention. In Fig. 12, the magnetic beam processing apparatus of the present invention generally includes a robot 20, an electric motor 21 set on a frame 50, a vibration generation apparatus 22, a plurality of magnetic units 23, for example, three magnetic units 23 in this figure, and a group of metal or nylon brushes 24 containing abrasive particles for rough polish. The above described vibration generation apparatus 22 includes a shaft bearing 25 fixed to the frame 50, a rotary shaft 26 connected to the electric motor 21 and supported freely rotating way among the shaft bearings 25, the rotary shaft 26 connected to the electric motor 21, a moving plate 28 set to a decentering cam 27 through a bearing 19, and a sliding rod 29 connected to the moving plate 28, and thus a rotation of the rotary shaft 26 is converted to the back and forth movement of the sliding rod 29 by the decentering cam 27. Here, although the vibration generation apparatus 22 is driven by the electric motor 21 according to the present invention, it can be driven by an oil hydraulics cylinder, an air cylinder, or an electrical cylinder.

[0045] The above described each magnetic unit 23 includes a base 30, a pair of magnetic pole support materials 31 set facing with each other, magnetic poles 16, for example "N" poles, and 17, for example "S" poles, the poles of which are opposite with each other set in the magnetic pole support material 31 facing with each other. The base 30 is set freely sliding way on rails 32 installed on the frame 50 and connected to each sliding rod 29, then the magnetic unit 23 is vibrated. The magnetic abrasive materials composed of pins made of feeble magnetism materials are inserted between the magnetic poles 16 and 17, thus the magnetic brush made of feeble magnetism materials, in which the magnetic abrasive materials are arranged along with the lines of magnetic power between the magnetic poles 16 and 17, is made up. Further, a liquid jet nozzle 37, which is installed for each magnet unit although only one liquid jet nozzle 37 is shown in Fig. 12, for processing or washing suitably is installed in the upper part of the magnetic unit 23, oil or liquid is jetted in the magnetic unit 23, and the polished chips are removed from the magnetic brush.

[0046] A work hold finger 35 is installed rotary way in a rotary arm 33 of the above described robot 20, and the work 1 can be installed and held in the work hold finger 35 in such a way that it can be put on and take off. A vibration apparatus 36 based on ultrasonic waves or high frequency waves is installed in the base of the rotary arm 33. Although only one robot 20 is shown in Fig. 12, a plurality of robots 20 the number of which is equal to the number of the magnetic units are installed around the magnetic units 23. Here, the robot is not always installed in the above described apparatus, but a hold apparatus to hold the work 1 may be employed in such a way that it can be put on and take off.

[0047] The magnetic beam processing employed in the present invention is used as a washing method for the above described aluminum parts as well. For example, when an adhesive agent is used in the parts production stage and then a stuck unnecessary adhesive agent is removed, the surface precision, micron precision, may be broken because the surface is melted. Further, mechanical effects are not added, so enough wash effects are not expected. In such a case, the magnetic beam processing can be employed for a surface wash of the parts, and the magnetic abrasive materials of the present invention can be used as the wash means. In this case, mechanical effects can be applied on the parts surface by magnetic power, and wash effects can be improved by adding the mechanical power to the wash power by wash liquid.

[0048] Figs. 14 and 15 are pictures of the carriage finish surface polished by the magnetic beam processing employed by the present invention. Here, Fig. 14 is an enlarged picture of the part of "A" of Fig. 7. Fig. 15 is an enlarged picture of the part of "B" of Fig. 7. The magnitude rate for the figures becomes large from the top to the bottom. Compared with the electrolytic polishing of Figs. 8 and 9, the surface is uneven obviously. Compared with the manual finish polishing of Figs. 5 and 6, although the surface is uneven slightly, the surface is scarcely notched like stripes traces as seen in Figs. 5 and 6, but it can be seen obviously that the angle portions are rounded. This is based on the following reason. Figs. 16 and 17 illustrate rough removal work of the bur by the metal brush. As seen in Fig. 16, the metal brush is rotating, then the carriage is approached and pressed, and the surface burs are removed. Therefore, as the motion is shown in Fig. 16, each of the metal wires of the brush cuts the bur and cleans the surface each by each, so the stripes traces as the marks are left on the abrasive traces as shown in Figs. 17A, 17B, and 17C. Therefore, the burs not removed are left on the edges as shown in Fig. 17A and the notched stripes traces are left on the edges as shown in Fig. 17C. In Fig. 17A, the burs are removed later by the knife using a microscope, if the burs not removed are left by any chance, they drop as the chip during HDD's working, then HDD may crash in danger. Further, the notches of Fig. 17C, which are made mostly on the final finish surface, cannot be removed. These notches might produce still smaller dusts from the edges. On the contrary, the burs and adhered dusts in the carriage surface which is polished as final finish by the magnetic beam processing employed by the present invention are removed by the magnetic abrasive materials being hitting the surface of the carriage as shown in Figs. 18A, 18B, 18C,

not recoverable is made, and finally big accident may happen in electric data processing.

[0053] A carriage for a hard disc drive polished as final finish has high surface precision of micron order. The finish surface is smooth, a cutting trace does not exist, and the surface layer is hardened uniformly by a magnetic material being hit by magnetic power. A cutting bur the edge of which is very tiny does not fall after installing the hard disc drive. The carriage for the magnetic head of the hard disc are not influenced by a temperature change and a seasonal change. The present invention forms a magnetic polishing brush by keeping magnetic abrasive material between magnetic poles in the carriage as a head arm member formed by extrusion molding or drawing for the magnetic head of the hard disc drive. The carriage of non-magnetic material as an aluminum part of HDD inserted in the above described magnetic polishing brush, is given reciprocation motion and vibration, thus the surface of the above described part is polished. The final finish is made by magnetic beam processing to polish or remove burs. Further, surface polish as final finish of the carriage is made by the above described magnetic beam processing using feeble magnetism, the relative magnetic permeability of which is 1.5 to 200, as the above described abrasive material. Further, stainless steel, nickel alloy or iron alloy having the same hardness as said stainless steel is used as the above described polish material.

Claims

1. A carriage produced by extrusion molding or drawing for a magnetic head of a hard disc drive, wherein:

   an objective part is inserted in a magnetic abrasive brush formed by magnetic abrasive material being kept between magnetic poles;
   magnetic beam processing method for polishing and removing burs on a surface of said part is applied by giving reciprocation or vibration motion; and
   said surface is polished as final finish.

2. The carriage for the magnetic head of the hard disc drive according to claim 1, wherein feeble magnetism the relative magnetic permeability of which is 1.5 to 2000 is used as said magnetic abrasive material.

3. The carriage for the magnetic head of the hard disc drive according to claim 2, wherein said magnetic abrasive material is made of stainless steel, or nickel allay or iron alloy having the same hardness as said stainless steel.

4. The carriage for the magnetic head of the hard disc drive according to claim 1, 2, or 3, wherein the shape of said magnetic abrasive material is cylindrical or a polygon section and an end face of which is a sharp pin.

5. The carriage for the magnetic head of the hard disc drive according to claim 4, wherein the diameter of said pin is 0.1 to 1.5 mm, the length of said pin is 0.1 to 1.5 mm, the shape of said pin is cylindrical, or the section of said pin is a polygon pillar and the length of said pin is 0.1 to 1.5 mm.

6. The carriage for the magnetic head of the hard disc drive according to claim 1, wherein said magnetic abrasive material is made by mixing different kinds of abrasive materials each size of which is different respectively.

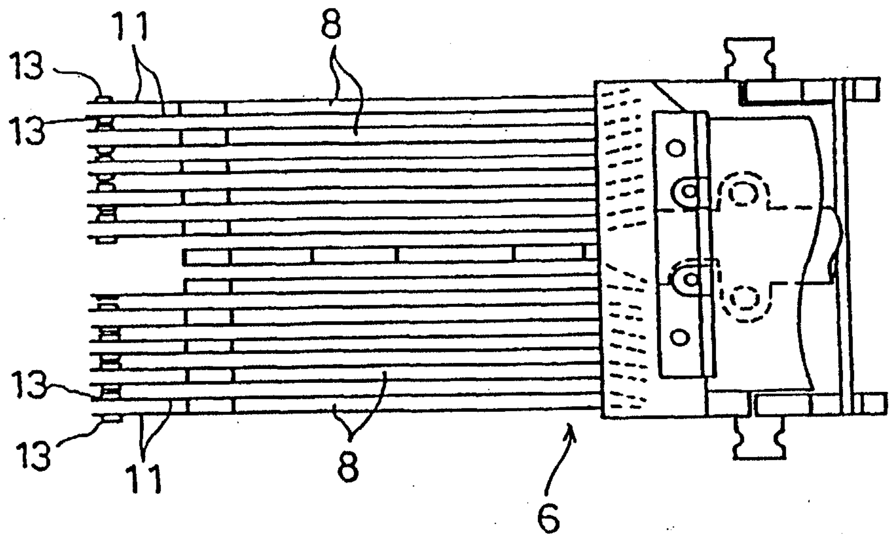

FIG. 2A

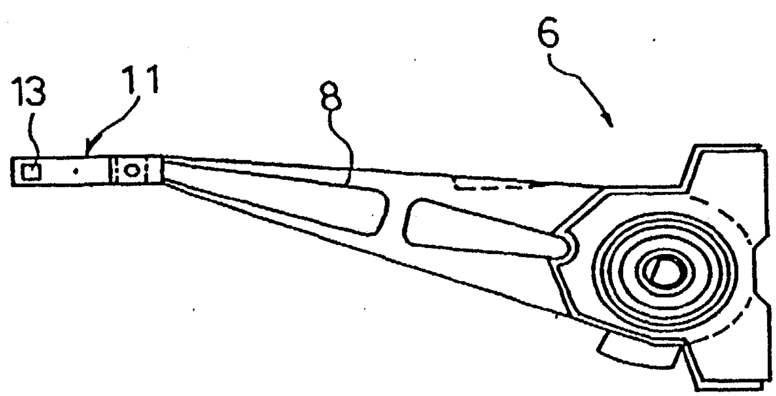

FIG. 2B

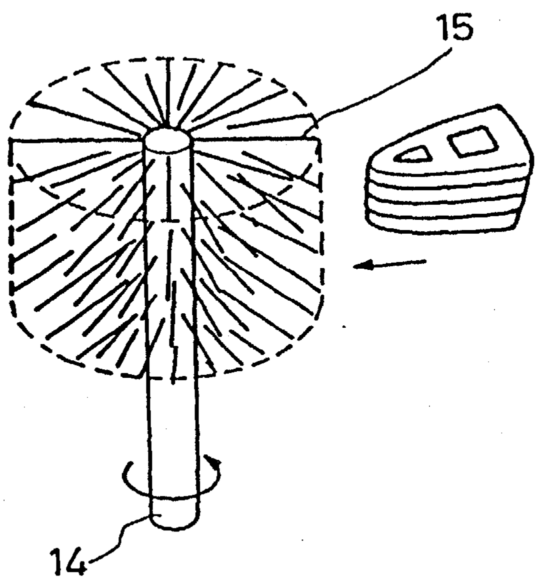

FIG. 4A

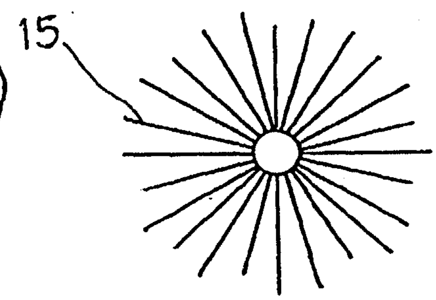

FIG. 4B

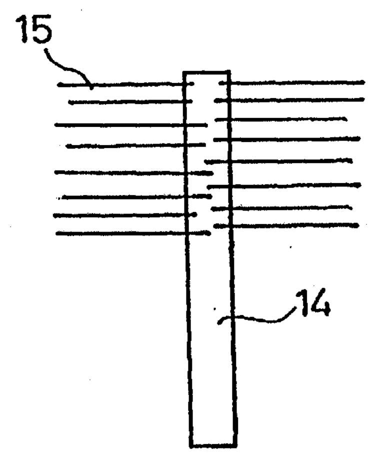

FIG. 4C

BRUSH PROCESSING + MANUAL PROCESSING

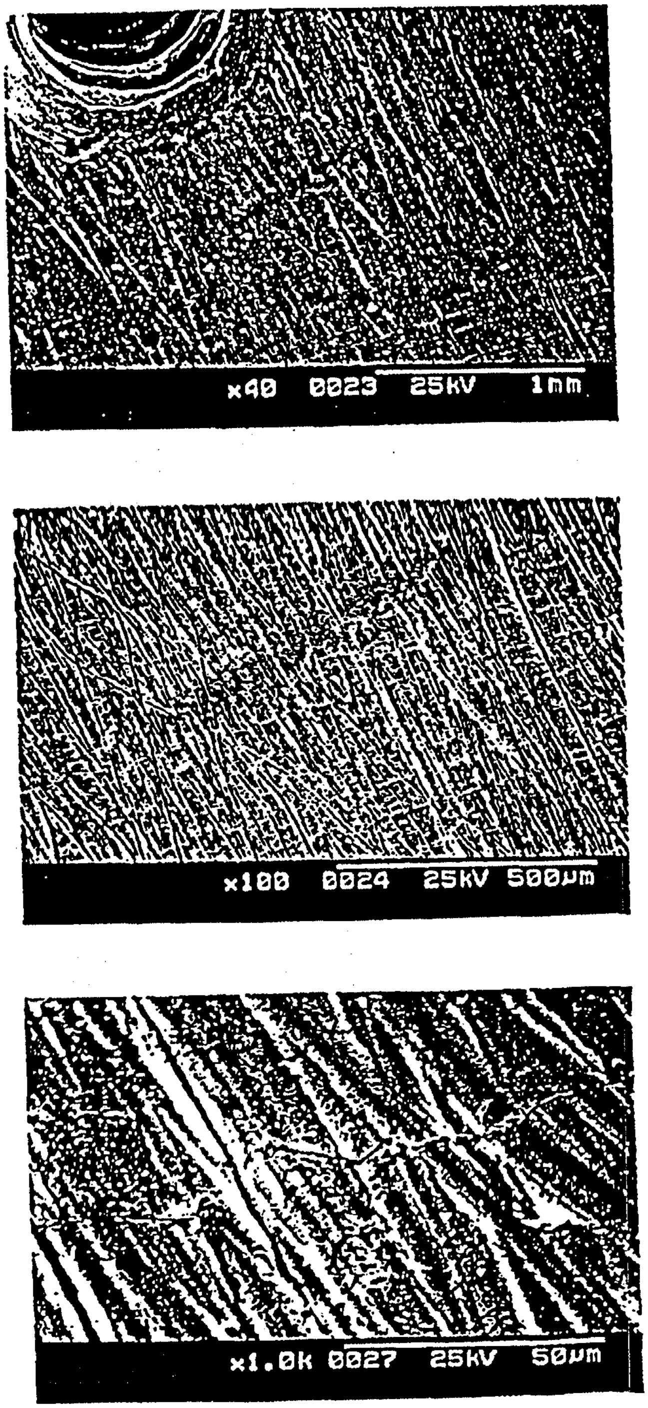

FIG. 6

ELECTROLYTIC POLISHING

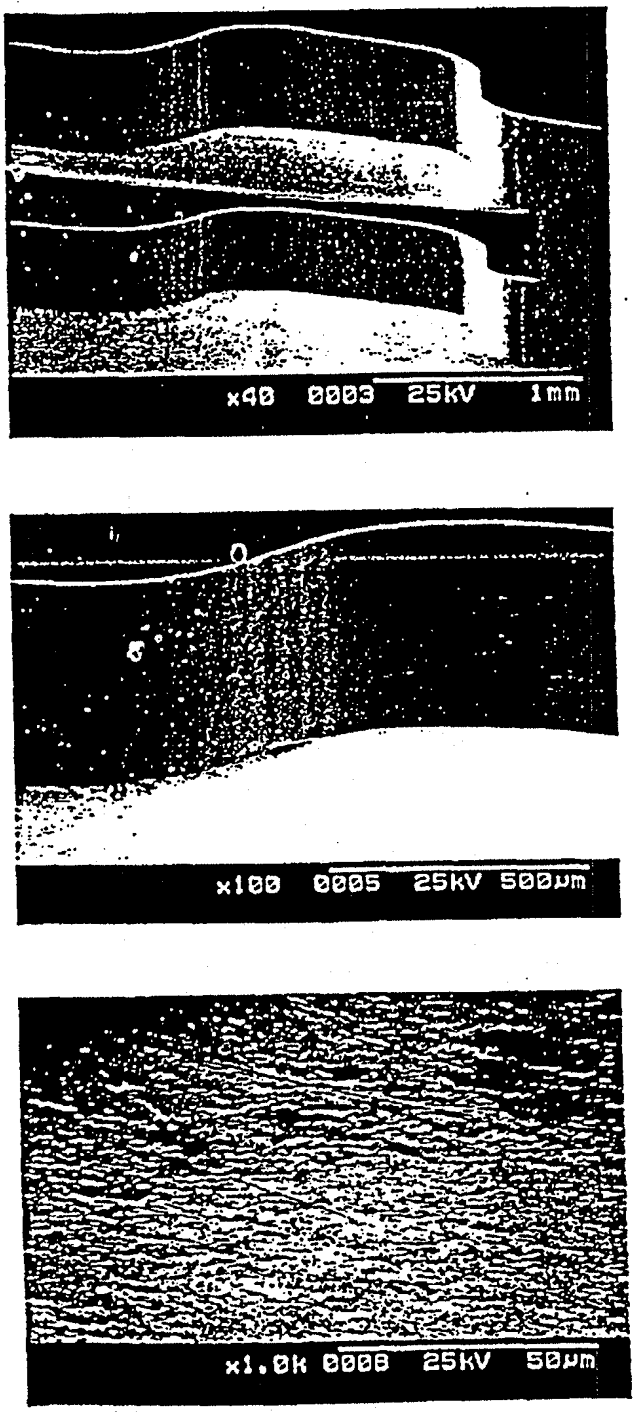

FIG. 8

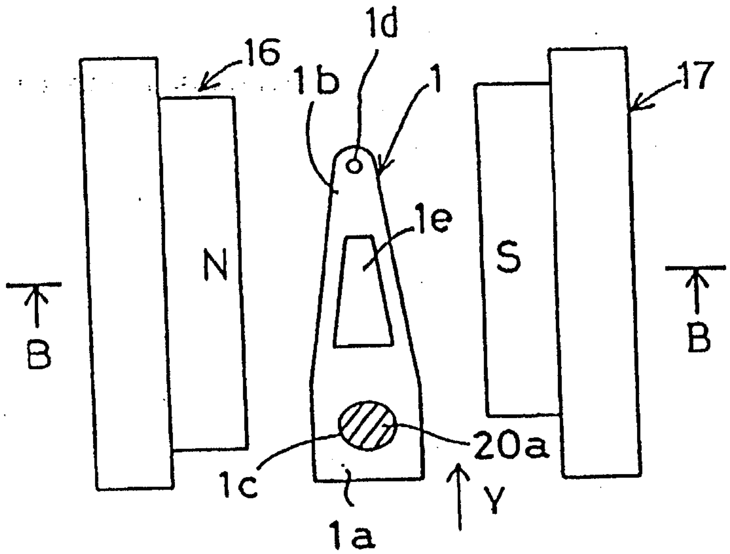

FIG. 10A

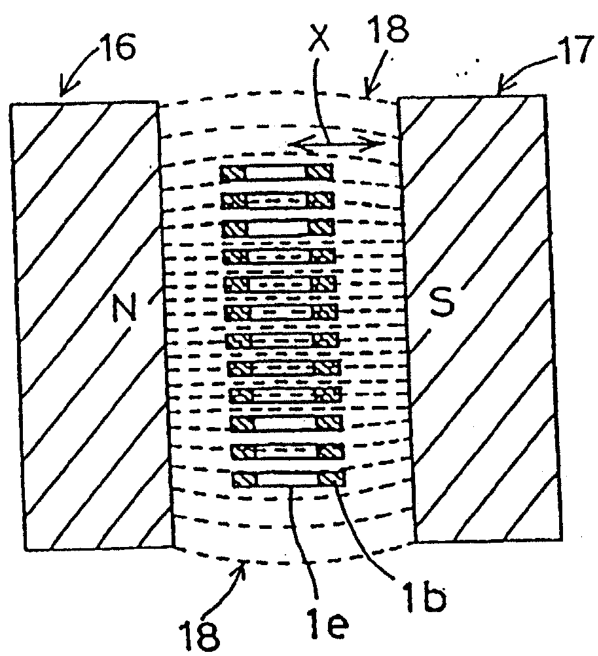

FIG. 10B

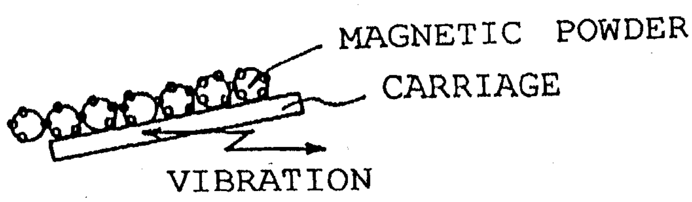

FIG. 11C

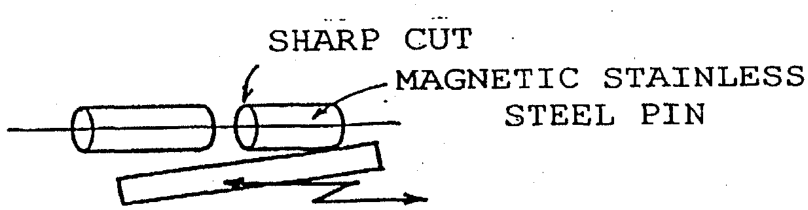

FIG. 11D

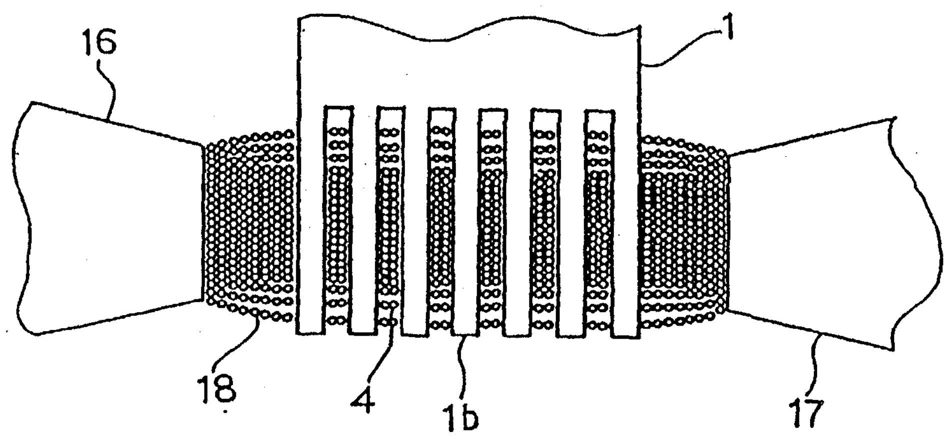

FIG. 13

MAGNETIC POLISHING (MAGNETIC BEAM PROCESSING)

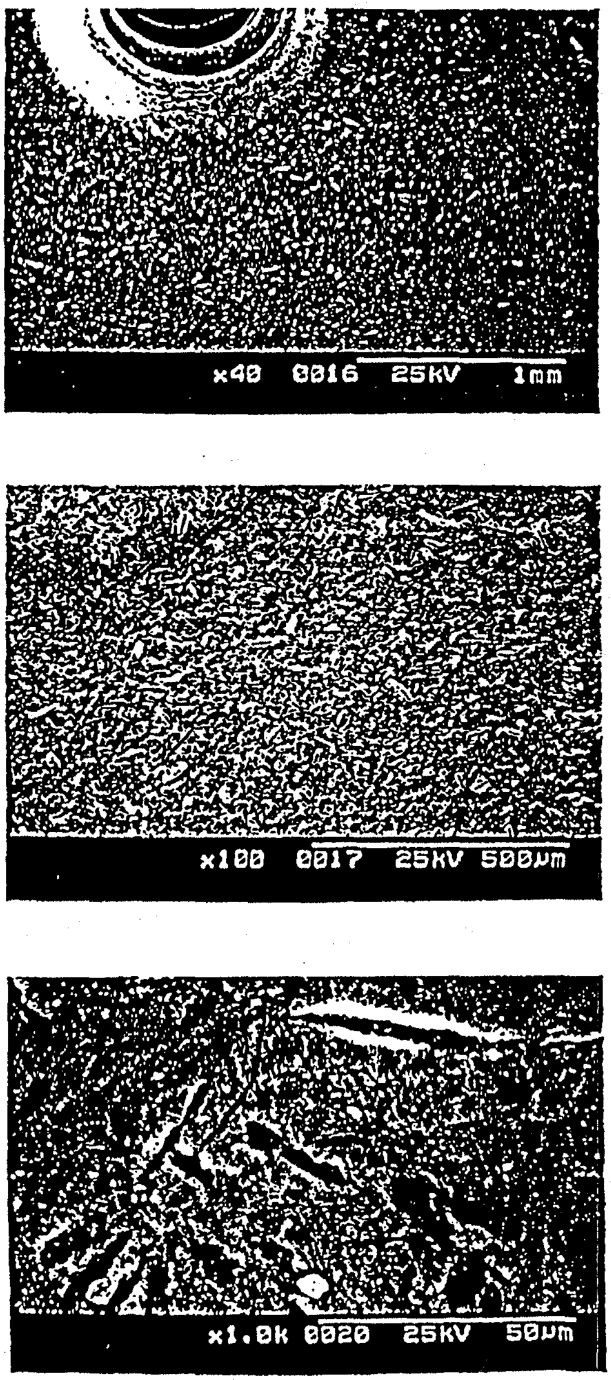

FIG. 15

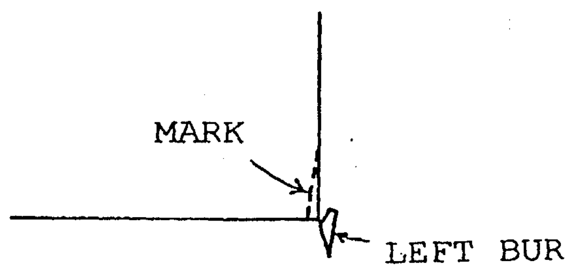

FIG. 17A

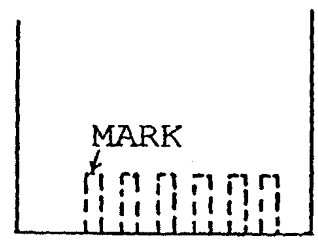

FIG. 17B

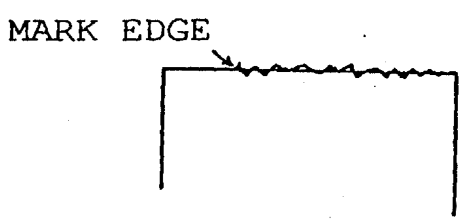

FIG. 17C

ELECTROLYTIC POLISHING

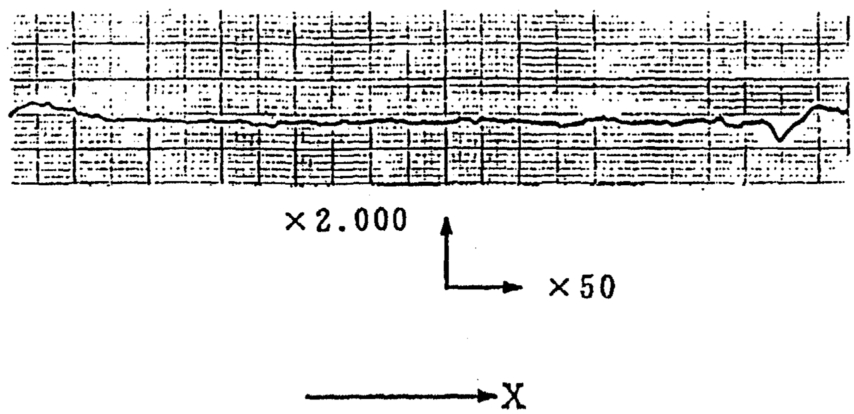

FIG. 19A

ELECTROLYTIC POLISHING

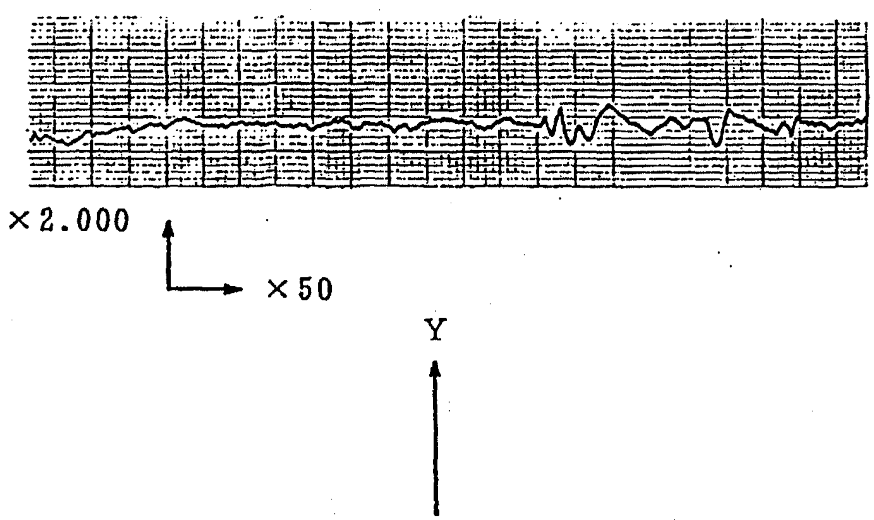

FIG. 19B

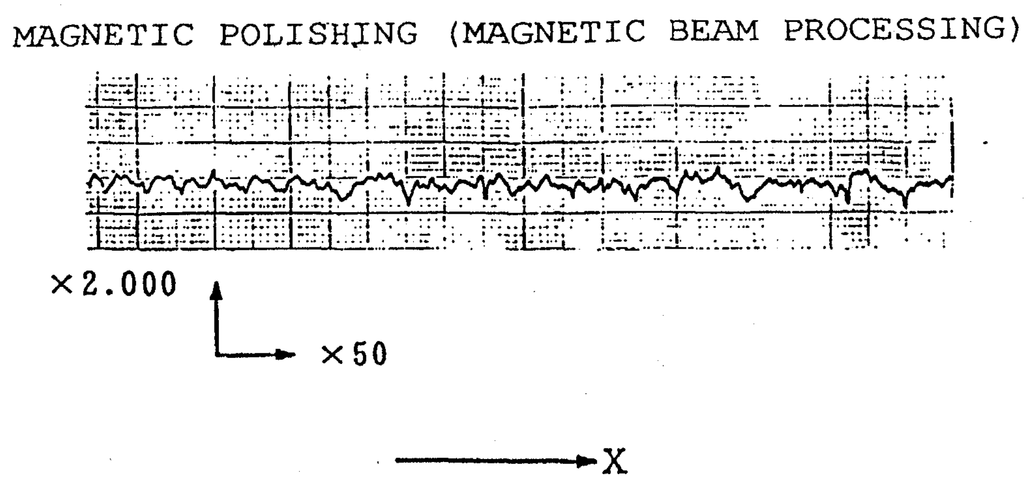

FIG. 21A

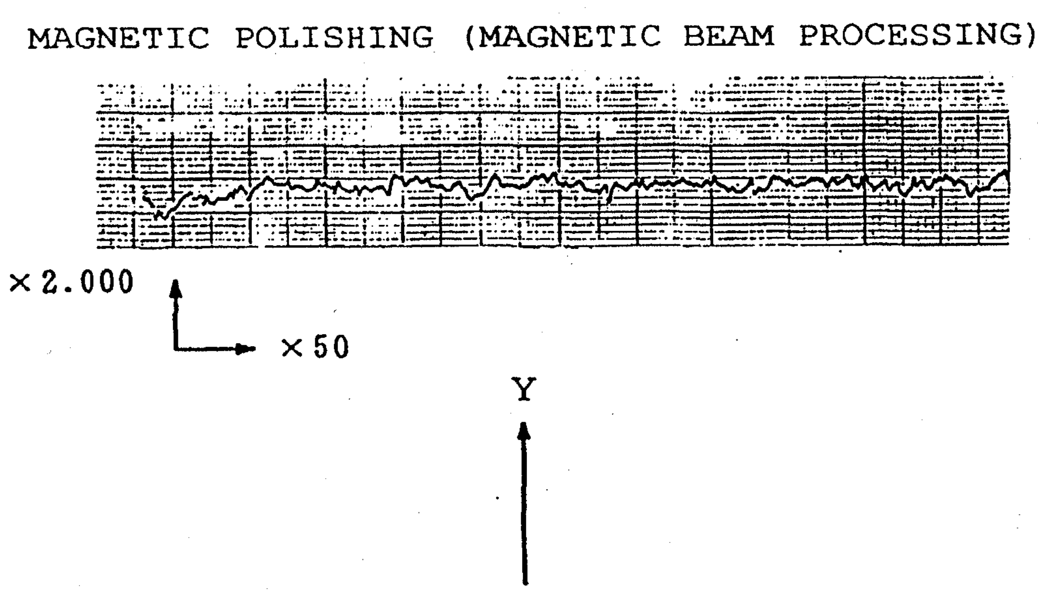

FIG. 21B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 12 0827

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X,P	EP 0 856 380 A (KYOEI DENKO CO., LTD.) 5 August 1998 * column 8, line 22 - line 44 * ---	1-5	B24B1/00 B24B31/112 G11B5/48
A	DE 36 34 409 A (FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG) 21 April 1988 * column 1, line 58 - column 2, line 12 * ---	1	
A	US 4 175 930 A (FADDEI J. SAKULEVICH ET AL) 27 November 1979 * column 3, line 9 - line 20; figures 1-4 * ---	1	
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 354 (M-1632), 5 July 1994 & JP 06 091519 A (ARIYAMA SEIKI SEISAKUSHO:KK;OTHERS: 01), 5 April 1994 * abstract * ---	1	
A	US 4 549 370 A (BORIS G. MAKEDONSKI ET AL) 29 October 1985 * column 2, line 34 - line 59; figure 2 * ---	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B24B G11B
A	US 2 883 809 A (LUTHER G. SIMJIAN) 28 April 1959 * column 2, line 61 - column 3, line 31 * ---	1	
A	US 4 685 937 A (SABURO HORI ET AL) 11 August 1987 * column 9, line 27 - line 39 * -----	6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	4 March 1999	Gerard, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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